## CONTENTS.

## PAPERS.

NO.	MONTH.		PAGE
461	(January.)	Progress Report of the Committee on Standard Rail Sections	1
462	(February.)	The Chignecto Ship Railway.	
		JOHN F. O'ROURKE	13
463	(do.)	Self-Purification of Flowing Water and the Influence of Polluted Water in the Causation of Diseases.	,
		CHARLES G. CURRIER	21
		Discussion on Paper No. 463.	
		By Charles B. Brush	59
		WILLIAM E. WORTHEN	60
		ALBERT R. LEEDS	62
		RUDOLPH HERING	65
		J. James R. Croes	68
		GEORGE W. RAFTER	70
		S. WHINERY	77
464	(do.)	Street Railway Track.	
		T. G. GRIBBLE	80
		Discussion on Paper No. 464.	
		By Edward P. North	129
		E. E. RUSSELL TRATMAN	129
		GEORGE R. HARDY	133
		A. J. HUTCHINSON	134
		John D. Elwell	135
		THOMAS H. GIBBON	140
		H. W. Brinckerhoff	148
		Mendes Cohen	149
		C, B, FAIRCHILD	150
		WILLIAM RICHARDSON	150
		ROBERT L. HARRIS	151
		WILLIAM P. SHINN	151
		Francis Collingwood	152
465	(March.)	On the Permanent Effects of Strain in Metals,	
		R. H. THURSTON	159
		Discussion on Paper No. 465.	
		By J. B. Johnson	164
		F. W. SKINNER	165
		H. T. EDDY	166
		Francis Collingwood	175
		D. J. WHITTEMORE	
		GEORGE E, THACKRAY	
		GEORGE R. HARDY	
		WILLIAM METCALF	
		PALMER C. RICKETTS	
		R. H. THURSTON	184
166	(do.)	District Steam Systems.	
		CHARLES E. EMERY	188

NO.	MONTH.		PAGE
467	(March.)	Steam Heating.	
		WILLIAM E. WORTHEN	206
		Discussion on Papers Nos. 466 and 467.	
		By James B. Francis	216
		CHARLES E. EMEBY	217
		WILLIAM J. BALDWIN	218
		W. Howard White	219
		H. W. Brinckerhoff	219
			219
		WILLIAM E. WORTHEN	213
468	(do.)	On the Use of Asphaltum in Sea Walls.	
	, , ,	W. C. AMBROSE	223
		Discussion on Paper No. 468.	
		By E. H. WOOTTON	225
			225
		A. FTELEY	226
		F. V. GREENE	-
		THEODORE COOPER	228
		EDWARD P. NORTH	228
		A. J. FRITH	228
469	(do.)	A Coffer Dam or Caisson without Timber or Iron.	
403	(40.)	ROBERT L. HARRIS	230
		IWBERT La HABRID	200
		Discussion on Paper No. 469.	
		By Charles Macdonald,	236
		J. FOSTER FLAGG	237
		T. C. CLARKE	237
		A. FTELEY	237
		J. N. OSTROM	238
		GEORGE R. HARDY	239
		CHARLES E, EMERY	239
		CHARLES B. BRUSH	240
		John Bogart	240
		EDWARD P. NORTH	240
		James Owen	241
			242
		Reuben Shirreffs	
		CLEMENS HERSCHEL	
		H. W. Brinckerhoff	
		R. L. HARRIS	245
470	(April.)	Comparison of Water Supply Systems from a Financial Point of	1
		View.	
		J. LELAND FITZGEBALD	247
		Discussion on Paper No. 470,	
		By DESMOND FITZGERALD	259
		JAMES B. FRANCIS	
		F. L. FULLER	
		CHARLES B. BRUSH	
		J. B. Johnson	
		T. H. McCann.	
		JOSEPH RAMSAY, JR	-
		WILLIAM METCALF	
		J. Leland FitzGerald	. 264
471	(do.)	Determination of the Stresses in Elastic Systems by the Method	i
		of Least Work.	
		WILLIAM CAIN	. 265

NO.	MONTH.		AGE
472	(May.)	The Beginnings of Engineering. By J. ELFRETH WATKINS	309
		Discussion on Paper No. 472.	
		By CLEMENS HERSCHEL	382
		WM. E. MERRILL	382
		D. J. WHITTEMORE	383
473	(do.)	Details of Valves and other Apparatus in use by National Water Works Company, Kansas City. FREDERICK E. SICKELS.	385
474	$(do_*)$	Automatic Refrigerator System, Denver. A. McL. Hawss.	389
			909
475	(do.)	Concrete Sewer at Mt. Vernon, N. Y. WILLIAM E. WORTHEN	393
		Discussion on Paper No. 475.	
		By WILLIAM E. WORTHEN	394
		J. FOSTER CROWELL.	395
		Horace Andrews	396
476	(do.)	Address at the Annual Convention at Chattanooga, Tenn., May 22d, 1891.	
		O. CHANUTE	397
477	(June.)	Report of the Committee on the cause of the fallure of the South Fork Dam	431
		Discussion on Paper No. 477.	207
		By P. F. Brendlinger	8.468
		Mr. Wilkins	466
		ROBERT MOORE	466
		F. Collingwood	
		HÉNRY T. GOLDMARK	467
		James B. Francis	468
478	(do.)	The Ravine du Sud, and Plan for averting its Overflow,	
-10	(00.)	By J. FOSTER CROWELL	470
		Discussion on Paper No. 478.  By Rudolph Hering	478
		W. E. MEBRILL	481
		FRANZ A, VELSCHOW	483
		J. FOSTER CROWELL	488
479	(do.)	The Nozzle as an Accurate Water Meter,	
	()	By John R, Freeman,	492
		Discussion on Paper No. 479	
		By WILLIAM BARCLAY PARSONS	513
		A. FTELEY	3-515
		Chas, B. Brush	516
		John C. Trautwine, Jr	518
		J. E. DENTON	520
		J. BURKITT WEBB	524
		J. R. FREEMAN	1-524
480	(do.)	Proportional Water Meter, to inferentially measure the total dis- charge of Nozzles.	
		By John Thomson	528
		Discussion on Paper No. 480.	
		By Lewis H. Nash	532
		J E DENTON	599

No.	MONTH.	P.	AGE
480	(June.)	Discussion on Paper No. 480.	
		J. BURKITT WEBB	5.6
		A. FTELEY	-536
		J. C. TRAUTWINE, JR	-537
		J. F. HOLLOWAY535-	-53c
		J. M. FREEMAN	537
		John Thomson	-535
481	(do.)	The False Ellipse reduced by Equations of Condition.	
		By Arthur S. C. Würtele	540
482	(do.)	Notes on a Mountain Slide.	
		By W. G. Curtis,	556
		Discussions on Paper No. 482.	
		By WILLIAM P. SHINN	561
		F. Collingwood	561
		J. FOSTER CROWELL	562
		CHARLES B. BRUSH	562
		P. F. Brendlinger	562
		I W WATTACE	563

## . ILLUSTRATIONS.

	11	LUBII(AIIUMS.		
PLATE.	MONTH,		PAPER.	PAGE
1.	(January.)	Designs for Rail Sections	461	12
11.	(do.)	Cut showing effect of Wear in Sharp	401	10
	(do.)	Curves	461	12
	<b>()</b>	ship railway to coasting trade	462	16
	(do.)	Topographical Map of Isthmus of Chig-		
		necto	462	16
	(do.)	Vessel in Lifting Dock	462	17
	(do.)	Railway Track Chignecto Ship Railway	462	18
	(do.)	Progress of Work at Amherst End	462	19
IV.	(February.)	Test Tubes, showing Growth of Bacteria	463	42
V.	(do.)	Water Bacteria, etc	463	42
VI-IX.	$(do_s)$	Photo-Micrographs of Animal Forms Found	409	76
		in Water	463	
	(do.)	Dea's System of Track	464	84
	(do.)	Mackinson's Rail and Support	464	88
	(do.)	Shaw's Saddle Rail and Supports	464	89
	(do.)	Rail used on Honolulu Tramways	464	91
	(do.)	Deacon's Removable Rail	464	94
	(do.)	Worn Sections of Street Rails of Glasgow	464	96
X-XII.	(do.)	Box-Girder Track Systems	464	112
XIII.	(do.)	Transition Curves for Turnouts, etc	464	125
	(do.)	Stresses on Rails,	464	99
	(do.)	Meakin's Rail	464	103
	(do.)	Johnson Rails and Chairs	464	105
	(do.)	Lewis and Fowler's Saddle Rail and Chair.	464	106
4.1	(do.)	Gibbon's Duplex Girder Rail and Chair	464	107
	(do.)	Page's Removable Rail	464	107
	(do.)	Improved Meakin Compound Rail	464	130
	(do.)	New York Grooved Girder Rail	464	130
	(do )	Boston Side-Bearing Girder Rail	464	131
	(do.)	European Girder Rails—Iron Paving Blocks,	404	100
	13.5	Scotland	464	132
	(do.)	Specimens of Depressed Rail Joints	464	136
	(do.)	Joint and Chair in Duplex Rail Systems	464	142
	(do.)	Sectional plan of Joint showing Wedges	464	147
	$(do_*)$	Rail devised for Horse Car Tracks on New York and Brooklyn Bridge	464	148
	1201	Rail devised for Horse Car Tracks on New	202	120
	(do.)	York and Brooklyn Bridge	464	152
	(40)	Barker and Cockburn—Muir Systems	464	156
	(do.)	Arrangements for Cable Roads	464	157
XIV.	(do.) (March.)	Strains in Metals	465	169
XV.	(do.)	64 43 44	465	164
XVI.	(do.)	46 46 46	465	178
XVII.	(do.)	46 46 46	465	182
XVIII.	(do.)	District Steam Systems	466	190
XIX-XX.	(do.)	di di	466	202
XXI.		***************************************		2072
AAL	(do.)	Steam Heating Merrimack Manufacturing	467	216
	(do.)	Apparatus for Separating Grease from		
	. ,	Steam	467	218
	(do.)	Steam Loop	467	220
XXII-XXIV.	(do.)	Caisson without Timber or Iron	469	236
	()			3.0

## VIII

PLATE.	MONTH.		PAPER.	PAGE
XXV.	(April.)	Elastic Systems	471	308
XXVI.	(May.)	Statue of Chaldean Architect, 4 000 B. C	472	309
XXVII.	(do.)	Ancient Engineering Instruments	472	384
XXVIII.	(do.)	Machine for cutting holes in large Water		
		Pipes while under pressure	473	388
XXIX.	(do.)	Pressure Regulating Valve	473	388
XXX.	(do.)	Section of Air Chamber on Water Main	473	388
XXXI-II.	(do.)	Suction Air-Vessel with Safety Attachment	473	388
XXXIII-IV.	(do.)	Air-valve for Water Main	473	388
XXXV.	(do.)	Concrete Sewer at Mt. Vernon, N. Y	473	388
XXXVI.	(June.)	Highest Water at Lewiston	477	432
XXXVII.	(do.)	Bridge at Lewiston at high water, after		
		three spans had fallen	477	432
XXXVIII.	(do.)	Bridge at Lewiston, showing Wreck after		
******	(400.)	the subsidence of the Water	477	432
XXXIX.	(do.)	Buttermilk Falls Trestle in the Conemaugh	477	434
XL.	(do.)	Wreck of the Day Express at Conemaugh	477	434
XLI.	(do.)	General View of the Broken Dam at South		
25.448.0	(400)	Fork, looking Northeast	477	436
XLII.	(do.)	View of the Break in the Dam looking East.	477	436
XLIII.	(do.)	View of the Break in the Dam looking West.	477	430
XLIV.	(do.)	Distant view of the broken Dam looking		200
ALAY.	(40.)	-	477	436
XLV.	(do.)	Remnants of the Gate Chamber in the Dam	477	436
		View taken from a point in the Wasteway,	211	200
XLVI.	(do.)	showing bridge and fish screens	477	436
XLVII.	13-1	Map of the Water Shed of the South Fork	211	300
YTAII.	(do.)	The state of the s	477	460
*** *****	13-1	Reservoir		
XLVIII.	(do.)	Dam and Sluices for Reservoirs	477	460
XLIX.	(do.)	Map showing rainfall within 50 miles of the		400
-	11-5	South Fork Reservoir	477	460
L,	(do.)	Plan and Profile of the Broken Dam and		400
	** *	Wasteway	477	460
LI.	(do.)	Diagram of the computed discharges of		
		water through the Wasteway, etc	477	460
LII.	(do.)	Diagram of the computed discharges of		
		water flowing into the South Fork Re-		
		servoir on May 30th and 31st, 1889		460
LIII.	(do.)	Profile of Dam and Elevation of Bridge		
		across Wasteway	477	464
LIIIA.	(do.)	A view of South Fork Dam before the Flood	477	466
LIV.	(do.)	General Map of the Ravine du Sud, Island		
		of Hayti	478	478
LV.	(do.)	Location Map, Ravine du Sud, showing		
		proposed channels		478
LVI.	(do.)	Typical Plans for Bank Protection, Ravine		
		du Sud		478
LVII-LXI.	(do.)	The Nozzle as a Water Meter-various		
		forms of Nozzles	479	513
LXII.	(do.)	Proportional Water Meter, using a Nozzle	480	53
		Topographical plan and profile of the		
		tunnel location		55
LXIII-LXIV.	(do.)	View of Mountain Slide and Hydraulic ap-		
		paratus used in removing it	482	564

